European REE resources: alkaline magmatism and beyond

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Europe has resources of many of the critical metals, particularly the rare earth elements (REE); yet economic, environmental and accessibility issues have combined to slow progress toward the exploitation of these resources. The EURARE project, funded by the EU's Seventh Framework programme, brings together a number of partners from across Europe to assess Europe's REE resources and to set the basis for an European REE industry. This talk will describe new research on some of the wide range of potential REE resources within Europe and showcase the diversity of resources available.

The most well-known REE resources in Europe are associated with alkaline magmatism and carbonatites. Recent research and exploration have focused on: 1) agpaitic syenites, including Mesoproterozoic intrusions of the Gardar Province in south Greenland and Norra Kärr in southern Sweden, and the Devonian plutons of the Kola Province; and 2) Palaeozoic to Mesozoic carbonatites across Scandinavia and west Greenland.

However, reviews of European REE resources show that a range of alternative deposit types are also of interest for their REE enrichment. In many cases, the REE in these localities could be produced as a by-product of another commodity, and these might therefore represent important opportunities to diversify European REE supply. Such deposit types include hydrothermal mineralisation associated with alkaline magmatism; placers associated with alkaline magmatism; and bauxites.

Hydrothermal mineralisation associated with alkaline magmatism

The largest REE deposits known in Europe are associated with large bodies of agpaitic syenite. However, many alkaline intrusions across Europe are miaskitic in composition and thus REE minerals are limited within the main body of the intrusion. Such intrusions commonly include late-stage pegmatitic sheets and/or hydrothermal veins that may be enriched in REE minerals. A classic example is the Triassic Ditrău Alkaline Complex in Romania, which has late-stage REE-rich mineral veins that include minerals such as bastnäsite, parisite, synchysite, apatite, allanite, monazite and xenotime in association with sulfides, carbonates and a wide range of other minerals. Our ongoing research is investigating the origin of these mineral veins and their relationship to the host alkaline magmatism.

Placers associated with alkaline magmatism

Intraplate, alkaline magmatism has developed throughout much of Europe during the Cenozoic, particularly around the margins of the Alpine collisional zone and along the Mediterranean. The surface expression of this alkaline magmatism commonly includes volcanic rocks of basanitic and alkali basaltic composition, and associated pyroclastic rocks. In many areas these eruptive products contained a range of heavy minerals that have been concentrated into fluvial and marine sediments: a well-known example is the Nettuno placers in Italy. In Turkey, heavy minerals derived from the Gölcük alkaline volcano are thought to have been concentrated in the placer deposit at Çanakli, which has been explored by AMR Mineral Metal Inc. for a range of metals. Our ongoing research looks at the link between the placer and the volcano, in order to assess the potential for low-grade REE enrichment in the wider areas around alkaline volcanoes.

Bauxites

Large resources of bauxite are well known across Europe, particularly in the Mediterranean region. Karst-type bauxites typically contain elevated concentrations of REE, in the form of authigenic REE-bearing minerals formed during the process of bauxitisation. The processing of bauxite to alumina, through the Bayer Process, produces a vast quantity of waste material known as red mud, which is stored in large onshore tailing ponds across Europe. REE originally in the bauxite ore are transferred to these red muds and hence represent a potential unexploited REE resource for Europe. Our ongoing research is investigating the potential low-grade, high-tonnage REE resources found in red mud, with a particular focus on deposits in Turkey and Greece.

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